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Characterizing the Physical Properties of Mississippi Zeolites

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The Mississippi Mineral Resources Institute
University, Mississippi 38677

CHARACTERIZING THE PHYSICAL PROPERTIES OF MISSISSIPPI ZEOLITES

By

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MMRI GRANT

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1983 PROGRESS REPORT
FOR CHARACTERIZING THE PHYSICAL
PROPERTIES OF MISSISSIPPI ZEOLITES

BACKGROUND

We, in the Chemical Engineering Department, began studying Mississippi zeolites in the Fall of 1982. In the spring of 1983, Mississippi Mineral Resource Institute granted us graduate student support. Our objectives were to determine the cation exchange capacity and to separate the zeolite from the native clay. Beginning July 1983, MMRI granted us funds for FY 1983-84,. to characterize the physical properties of Mississippi zeolite. Our objectives were:

1. Determine ion exchange properties;:
2. Determine mineralogical composition of Mississippi zeolite;
3. Determine the Morphology of Mississippi zeolite;
4. Determine surface area/pore volume characteristics;
5. Determine chemical composition of Mississippi zeolite;
6. Determine water adsorption properties; and
7. Continue review of literature and search for contacts on Methods for separating clays and zeolites.

ACCOMPLISHMENTS/FINDINGS

© We accomplished all our objectives by the end of calendar 1983, except for numbers 5 and 6. The results of our work are detailed in Mr. Lieu's thesis, which is included. In summary we found the Mississippi zeolites had a very irregular crystalline structure almost completely covered by montmorillonite (clay). Despite significant conversion to montmorillonite cation exchange capacities ranged from 61.41 to 89.57 meq/100 grams. The Mississippi zeolites should therefore be of some commercial use. Other findings were as follows:

- It appears the montmorillonite grows out of deteriorating zeolite crystals. The zeolite and clay are thus not readily separable.
- Pretreatment of Mississippi zeolite with acid and base, in an attempt to increase their cation exchange capacities, proved ineffective and sometimes harmful.
- Thermally regenerating samples to remove ammonia required heating times of 2 to 5 hours at 450°C with only 77% retention of original exchange capacity. However, mechanical strength improved significantly.
- © Leaching with kCl solution gives more effective ammonia regeneration. Repeated washing cycles with NaCI, $CaCl_2$ and KCI improve the cation exchange capacity up to 39%. We feel this is significant for reuse or enhancement of exchange capacity.
- Surface areas ranged between 25 to 65 M^2/gram, with pore size predominantly at 0.01p.

In short we have completed about 75% of our objectives with about half the time and half the funding originally requested. We have obtained definitive results and documented them in a thesis.

IMPLICATIONS

Findings to date indicate that some Mississippi zeolites are suitable for bulk applications in ammonia exchange. These include agriculture, aquaculture, and waste water treatment. While not as pure as western zeolites, the Mississippi zeolites have significant cation exchange capacity. Their use in the state and region will benefit from lower transportation costs thus making them more competitive.